THE KNOWN GEOGRAPHIC DISTRIBUTION OF THE MEXICAN MAYFLY GENERA IN NORTH AMERICA (INSECTA : EPHEMEROPTERA)

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A review of the known distribution of the Mexican genera has provided additional data on the origin and distributional limits of the North American Ephemeroptera. Distributional studies have been generally neglected by Ephemeropterists, and the combining of mayflies with maps is almost non-existent in recent publications. EDMUNDS (MS), in 1968, at the Entomological Society of America meetings in Denver, Colorado, discussed the origin and distributional limits of the mayfly genera of North and Central America, and he grouped 58 genera by phylogenetic-geographic and ecological affinity. In our attempt to determine the possible origin and distributional limits of the Mexican genera we have based our conclusions upon the known distribution of these genera without regard to phlyogenetic or ecological data. The distributional data are from published records, and from determined collections at California State College at Los Angeles and the University of Utah, Salt Lake City. We express gratitude to Dr. George F. EDMUNDS, Jr. of the University of Utah for allowing us to include several unpublished collection records, and for aiding us in the preparation of this paper.

There are 21 genera presently known to occur in Mexico and 8 are considered to be boreal in origin, 12 to be austral, and one genus, *Choroterpes*, is of questionable origin. EDMUNDS (MS) established six categories in which he placed the North and Central American genera, and whereas our distributional classification generally agrees with his, we propose seven categories and a new terminology to express the distributional limits of the Mexican genera. The new nomenclature used here is based upon the presumed origin of the genus, and the temperature zone of the earth in which the genus reaches its most northern or southern distribution. The distributional categories, the number of genera included in each category, and the latidudinal limit of each category are as follows (Map 1) :

1. BOREAL-LOWER NORTH TEMPERATE. This category includes boreal genera whose most southern distribution is between 30-40° north latitude and 2 genera are included here.

2. BOREAL-UPPER TROPICAL. This category includes boreal genera whose most southern distribution is between 10-20° north latitude, and this category includes 5 genera.

3. BOREAL-LOWER SOUTH TEMPERATE. This category includes only a single genus whose most southern distribution is between 45-50° south latitude.

4. AUSTRAL-UPPER TROPICAL. This category includes only one Mexican genus, but the northern distribution of 4 additional Central American genera of austral origin also have their most northern distributional limits here. The most northern distribution of these genera is between 10-20° north latitude, and the most southern distribution of 5 boreal genera is also between these latitudinal limits.

5. AUSTRAL-LOWER NORTH TEMPERATE. This category includes 4 austral genera whose most northern distribution is between 30-40° north latitude. The most southern distribution of 2 boreal genera is also within 30-40° north latitude.

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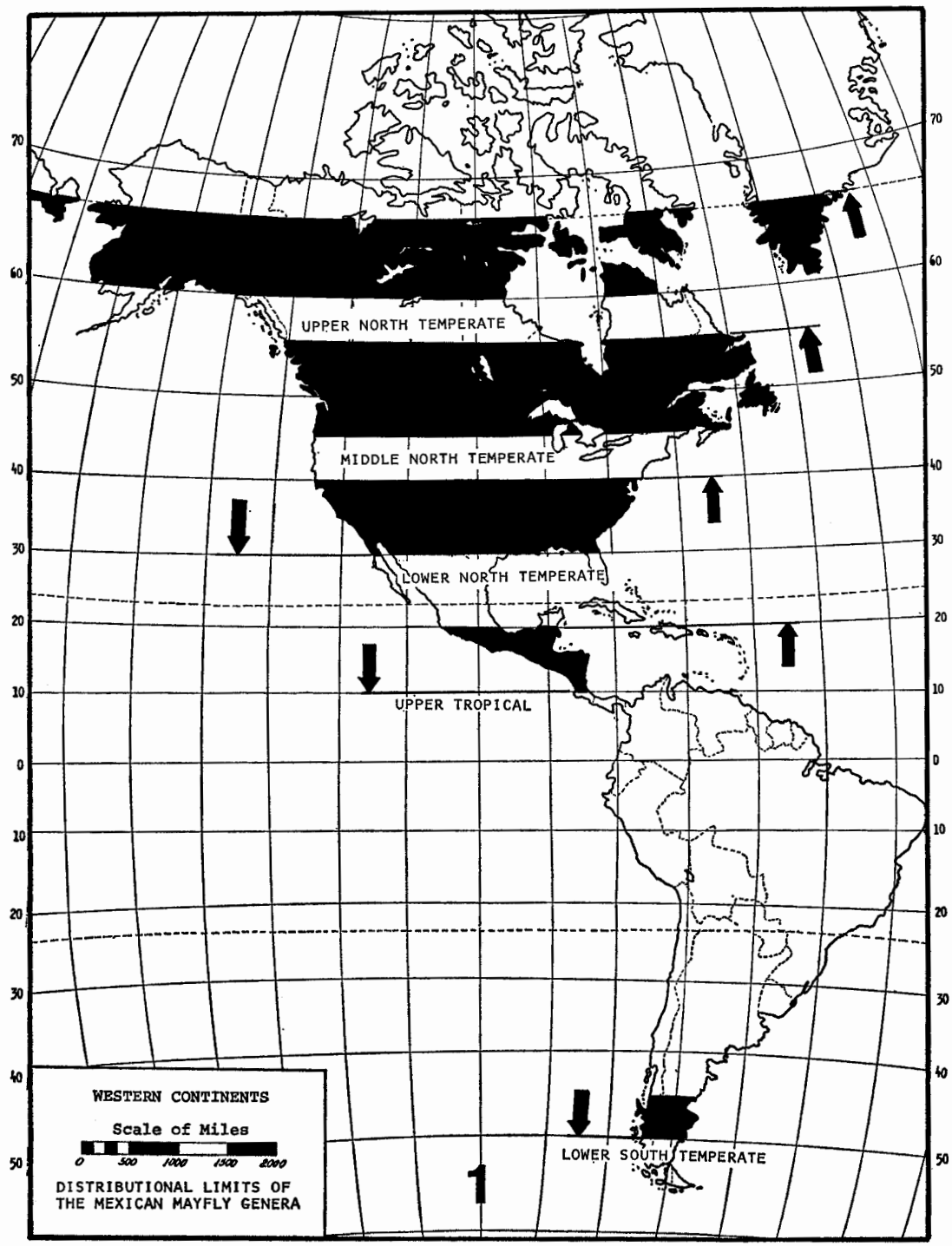
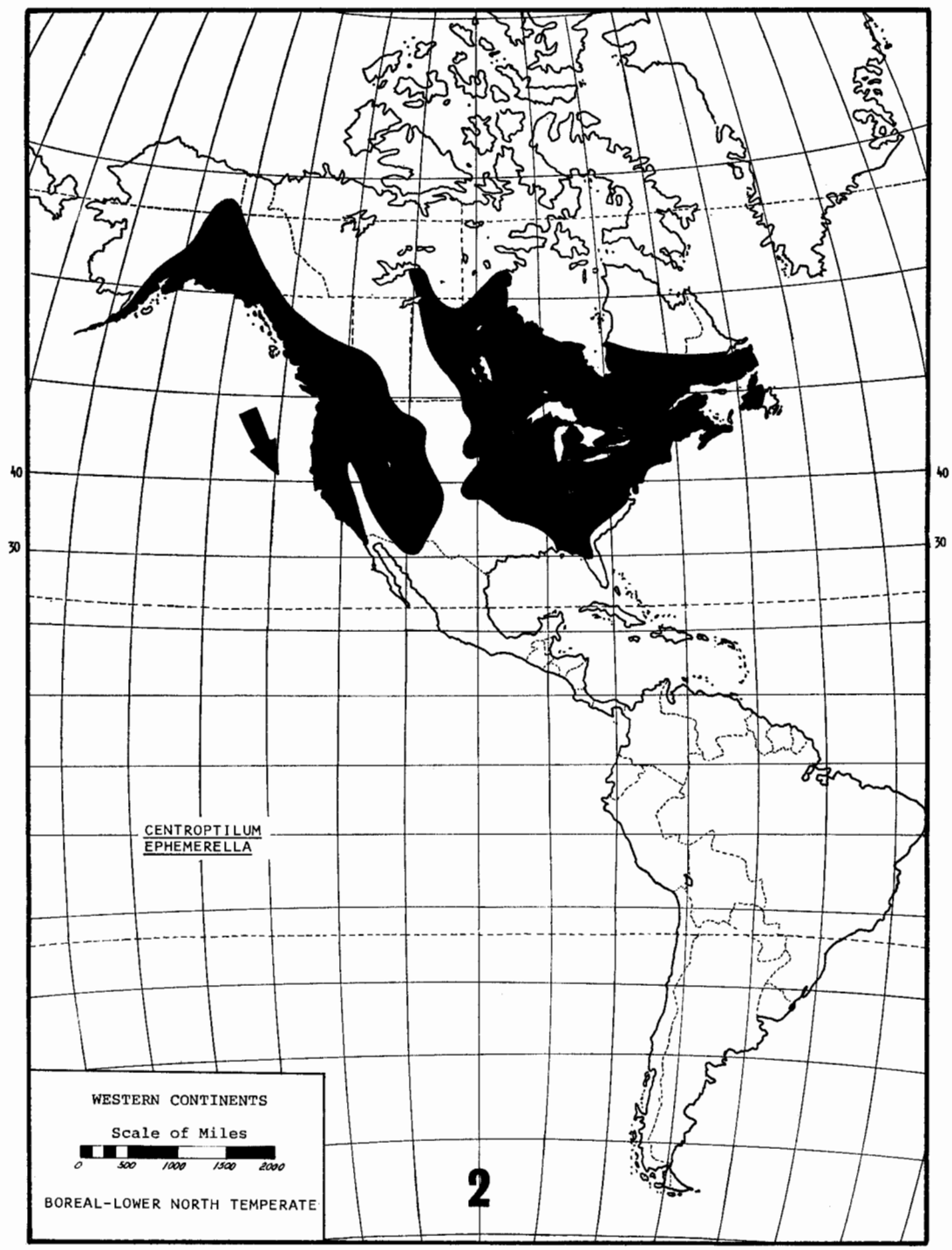


MAP 1. Distributional limits of the Mexican mayfly genera.

from A.J. Nijstrom & Co., Desk Map No. 8



MAP 2. Boreal-lower north temperate.

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6. AUSTRAL-MIDDLE NORTH TEMPREATE. This category includes 5 austral genera whose most northern distribution is between 45-55° north latitude.

7. AUSTRAL-UPPER NORTH TEMPERATE. This category includes 2 austral genera whose most northern distribution is between 60-65° north latitude.

BOREAL-LOWER NORTH TEMPERATE

This distributional category (Map 2) includes the genera *Ephemerella* and *Centroptilum*, and there appears to be no question that the origin of these taxa was boreal.

Centroptilum is composed of approximately 55 described species of which 25 are known from the Nearctic Region, 10 from the Palaearctic, 17 from the Ethiopian, 2 from the Oriental, 1 from the Australian, and the genus has never been reported from the Neotropical Region. The greatest concentration of species of *Centroptilum* is in the northern hemisphere, and in the Nearctic Region 15 of the 25 described species are Canadian, and only 2 species are known from as far south as Florida. The only record of this genus from Mexico was reported by EATON (1892) based upon specimens collected in north Sonora.

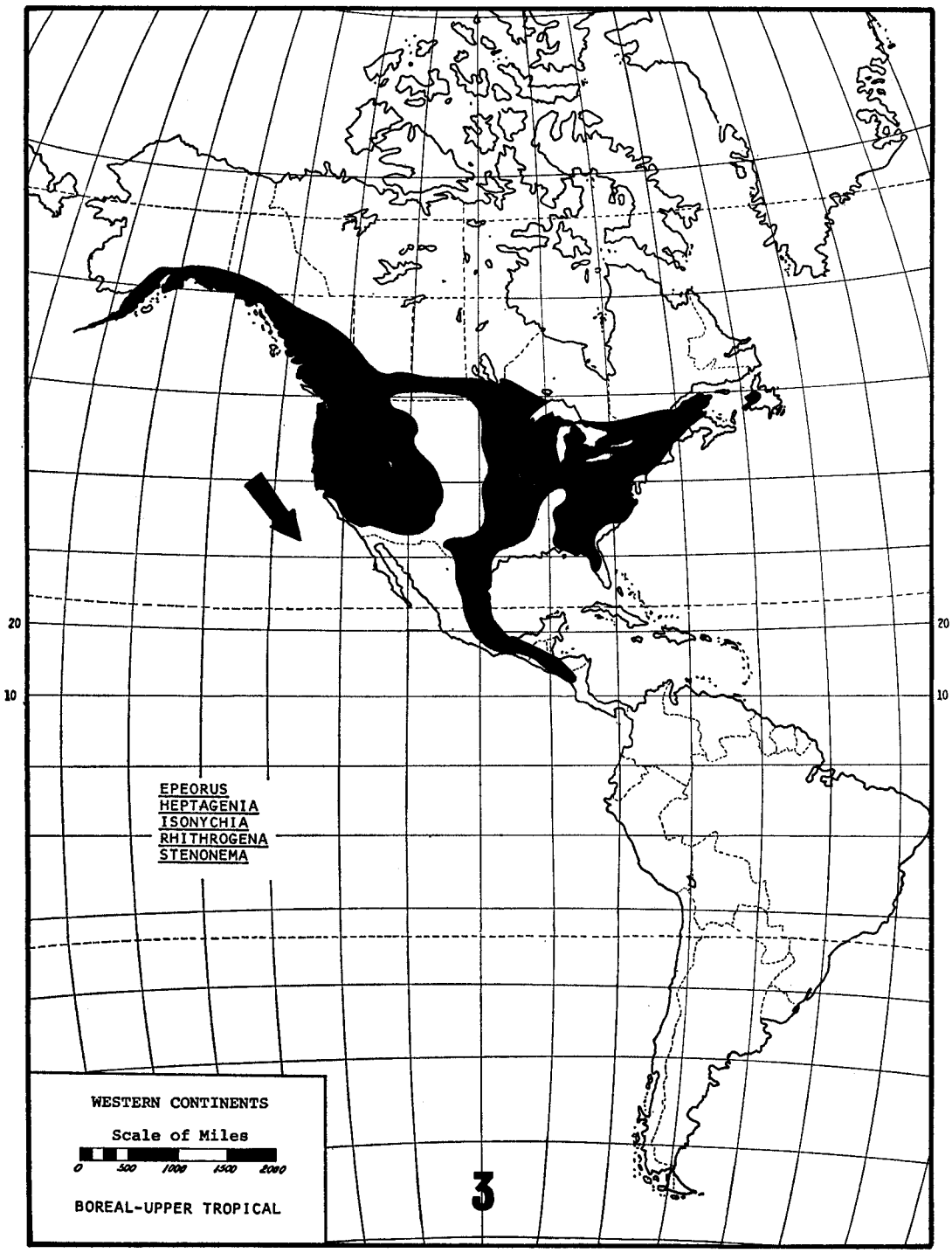
The genus *Ephemerella* includes approximately 125 species of which 83 are known from the Nearctic Region, 38 from the Palaearctic, 5 from the Oriental, and only 1 from the Ethiopian. The genus has not been reported from the Australian and the Neotropical Regions. The most southern distribution of this genus in the Nearctic Region is northern Florida in the eastern part of North America and northern Mexico in the western part. BERNER (1946) described three species from northern Florida, and EATON (1892) reported specimens as *Ephemerella* sp. from north Sonora. *Ephemerella micheneri* and E. *flavilinea* also are known from northern Baja California.

BOREAL-UPPER TROPICAL

The five genera included in this category (Map 3) are *Epeorus*, *Heptagenia*, *Isonychia*, *Rhithrogena*, and *Stenonema*, and a boreal origin of these taxa appears to be certain as the great majority of the described species are Holarctic in distribution. There are approximately 220 species included in these genera, and only 7 species are known to occur in the Neotropical Region, 12 are known from the Oriental, and the Ethiopian and Australian Regions are without records of these genera.

The distribution patterns of *Epeorus*, *Heptagenia*, *Rhithrogena*, and *Stenonema* in North and Central America are nearly identical as they have three disjunct populations, one in western North America, one in eastern North America, and one in Mexico and Central America. The western North American species are known from Alaska to southern California, Arizona, and New Mexico, the eastern North American spccies are known from southern Canada to Texas and northern Florida, and the mexican and Central American species are known from southern Mexico to Panama.

The genus *Isonychia* includes approximately 34 species of which 29 are Holarctic in distribution. There are only 2 species reported from the Neotropical Region, 2 from the Oriental, and the genus is presently not known from the Ethiopian and Australian Regions. In North America the genus is distributed from southern Canada to southern Mexico and one species, *Isonychia sicca*, is known to occur from Alberta and Manitoba, Canada, to Tabasco, Mexico. An undescribed species of *Isonychia* is also known from Honduras.



MAP 3. Boreal-upper tropical.

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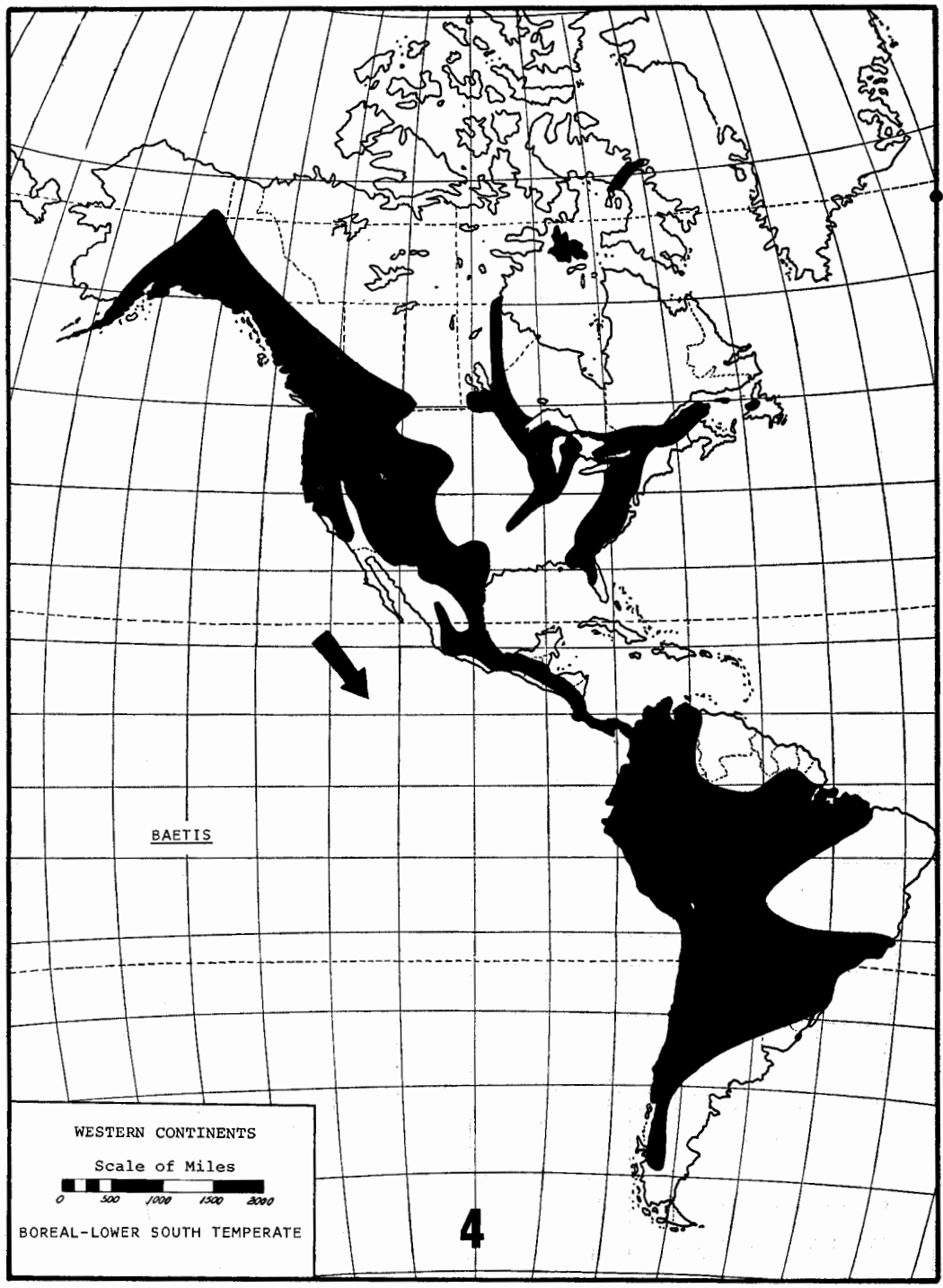

MAP 4. Boreal-lower south temperate.

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Boreal-Lower South Temperate

The genus *Baetis* is included alone in this category (Map 4), and the known distribution of the taxon suggests a boreal origin. *Baetis* includes approximately 140 described species, and records have been reported from every biogeographical region. The majority of species are Holarctic with over 90 species, approximately 25 are Neotropical, 10 each have been reported from the Ethiopian and Oriental Regions, and only 2 are presently known from the Australian. In the New World the genus is known from Alaska, northern Canada, and Iceland to the southern tip of Argentina. It is possible that this taxon had an austral origin, but the great number of species known from the northern hemisphere, and the fact that over 65 per cent of the Nearctic species have been described from the northern part of North America would seem to discount this hypothesis.

Austral-Upper Tropical

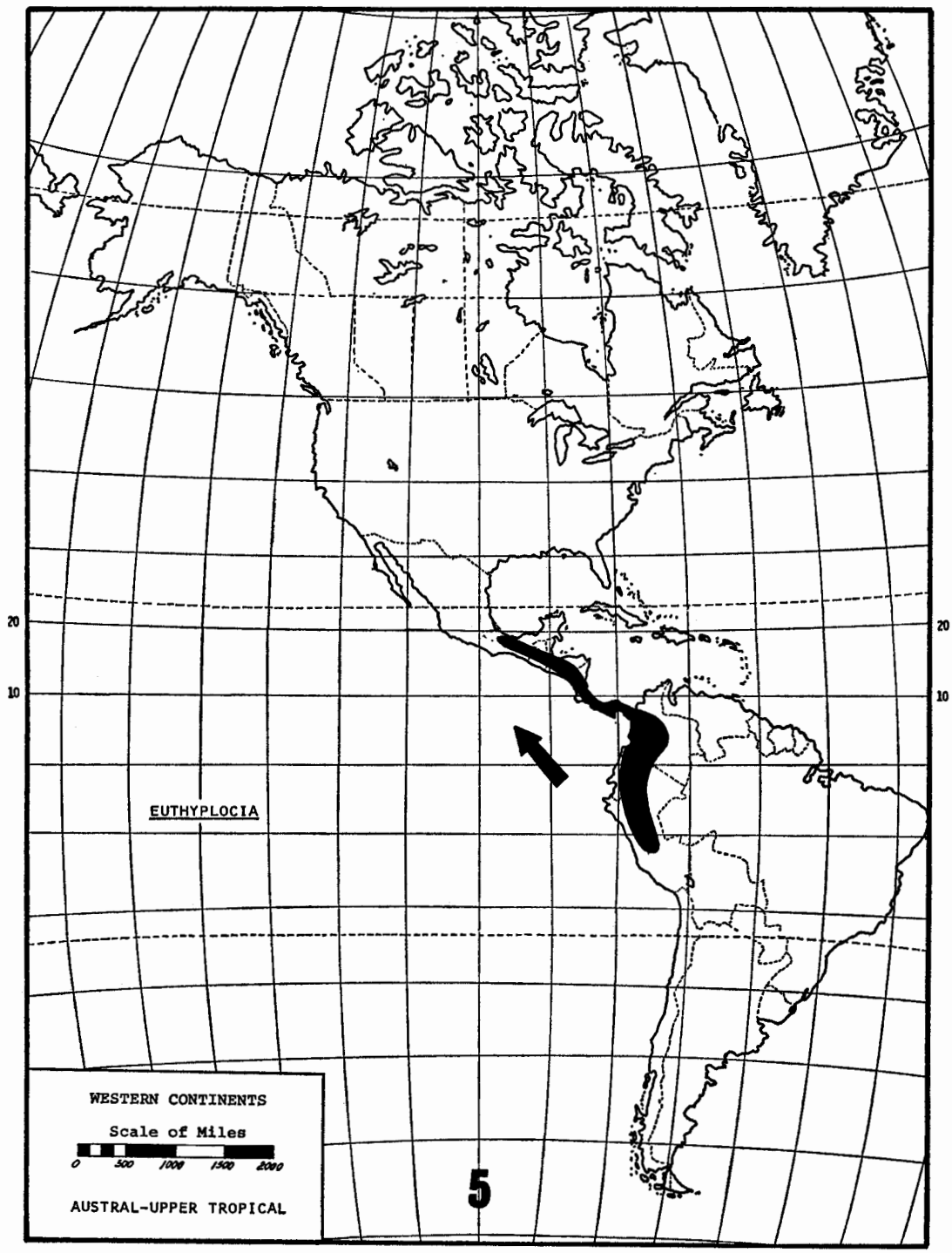
Euthyplocia is the only Mexican genus included in this distributional category (Map 5), and there is little doubt that the origin of this taxon was austral. The genus includes only 2 described species and the taxon is known from Peru to southern Mexico. Four additional New World genera presently known from Central America, but not yet collected in Mexico, also fit into this category. These genera are *Haplohyphes*, *Hermanella*, *Homothraulus*, and *Campylocia*. All of these taxa have only 2 described species, except *Campylocia* which has 3. *Haplohyphes* is known from Peru and Costa Rica, *Hermanella* and *Homothraulus* are known from Argentina to Honduras, *Hagenulopsis* is known from Brazil to Honduras, and *Campylocia* has been reported from Brazil to Costa Rica.

Austral-Lower North Temperate

This category (Map 6) includes four genera, *Baetodes*, *Campsurus*, *Leptohyphes*, and *Thraulodes*, and all are New World in distribution. There are 199 described species in these genera and 169 are Neotropical and only 30 are Nearctic. The genus *Baetodes* includes 21 described species, and the most northern distribution of the genus is in Arizona and Texas in western North America. *Campsurus* has almost 50 described species and the genus is known from as far north as central Texas; *Leptohyphes* has over 70 described species and it is known to occur as far north as southern Utah in western North America and Maryland in eastern North America; and the most northern limits of the genus *Thraulodes*, with over 50 described species, is Arizona, New Mexico, and Texas.

Austral-Middle North Temperate

Dactylobaetis, *Lachlania*, *Tortopus*, *Traverella*, and *Tricorythodes* are included in this distributional category (Map 7), and the austral origin of these genera is supported by the great concentration of described species in the southern hemisphere. These genera are all restricted



MAP 5. Austral-upper tropical.

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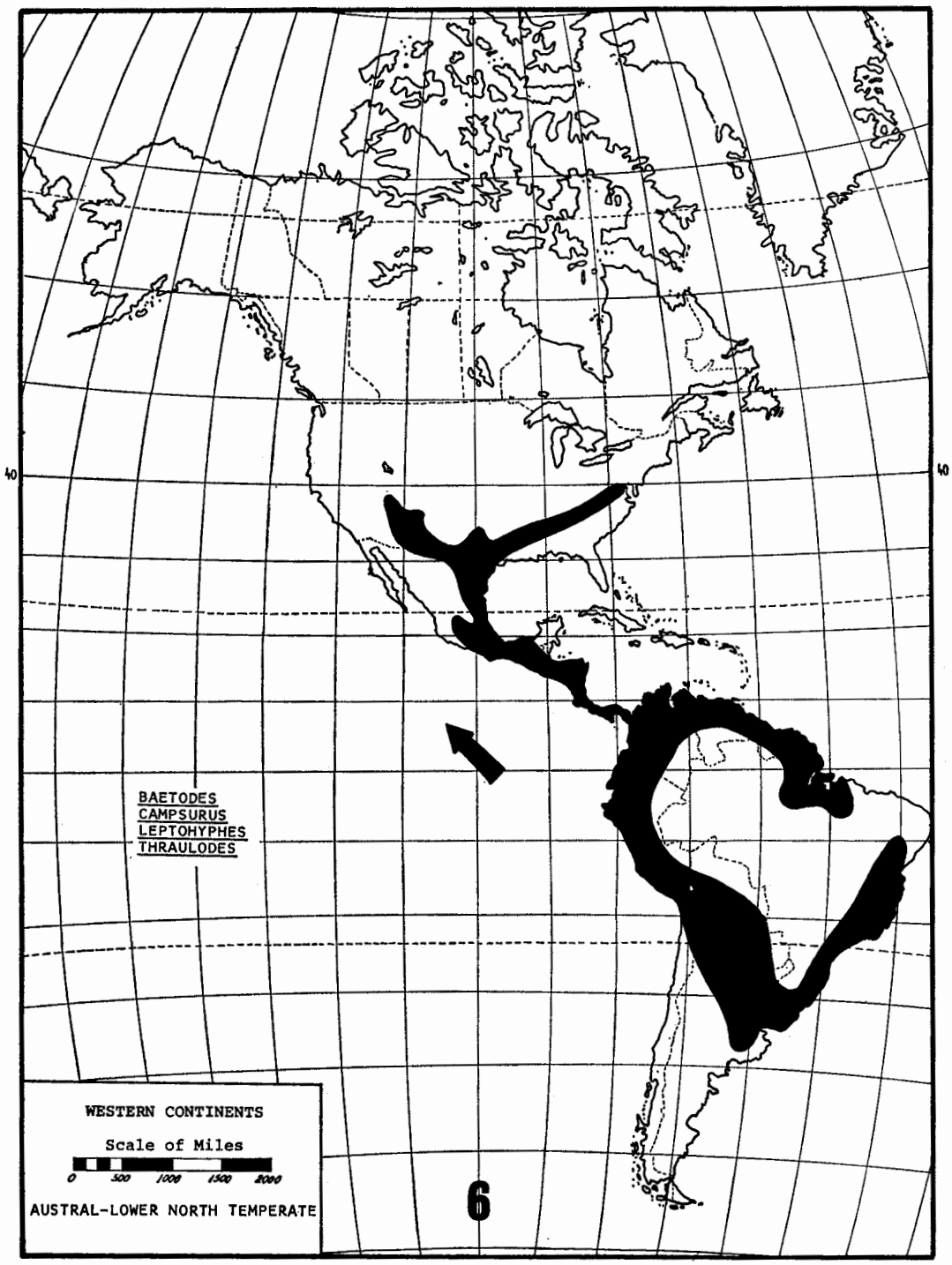


MAP 6. Austral-lower north temperate.

from A.J. Nijstrom & Co., Desk Map No. 8

to the New World, and all have a small to a moderate number of described species. *Dactylobaetis* includes 18 species, of which only 4 are Nearctic, and the most northern limits of the genus is Idaho and Oregon in western North America. The other four genera are known to occur as far north as southern Canada, and more than 60 percent of the included species in these genera are Neotropical. *Lachlania* is composed of 7 species, *Tortopus* of 5, and *Traverella* of 13, and only 3 species of each genus are Nearctic. The genus *Tricorythodes* is large by comparison to the others with 38 described species, and 24 are Neotropical and only 14 are Nearctic. An austral origin of *Tricorythodes* is also supported by the fact that the great concentration of the species known to occur in the Neartcic Region is in the southern United States from southern California to Florida.

Austral-Upper North Temperate

The genera *Callibaetis* and *Hexagenia* are included in this category (Map 8), and these taxa are known to occur from the southern tip of South America to the northern reaches of North America.

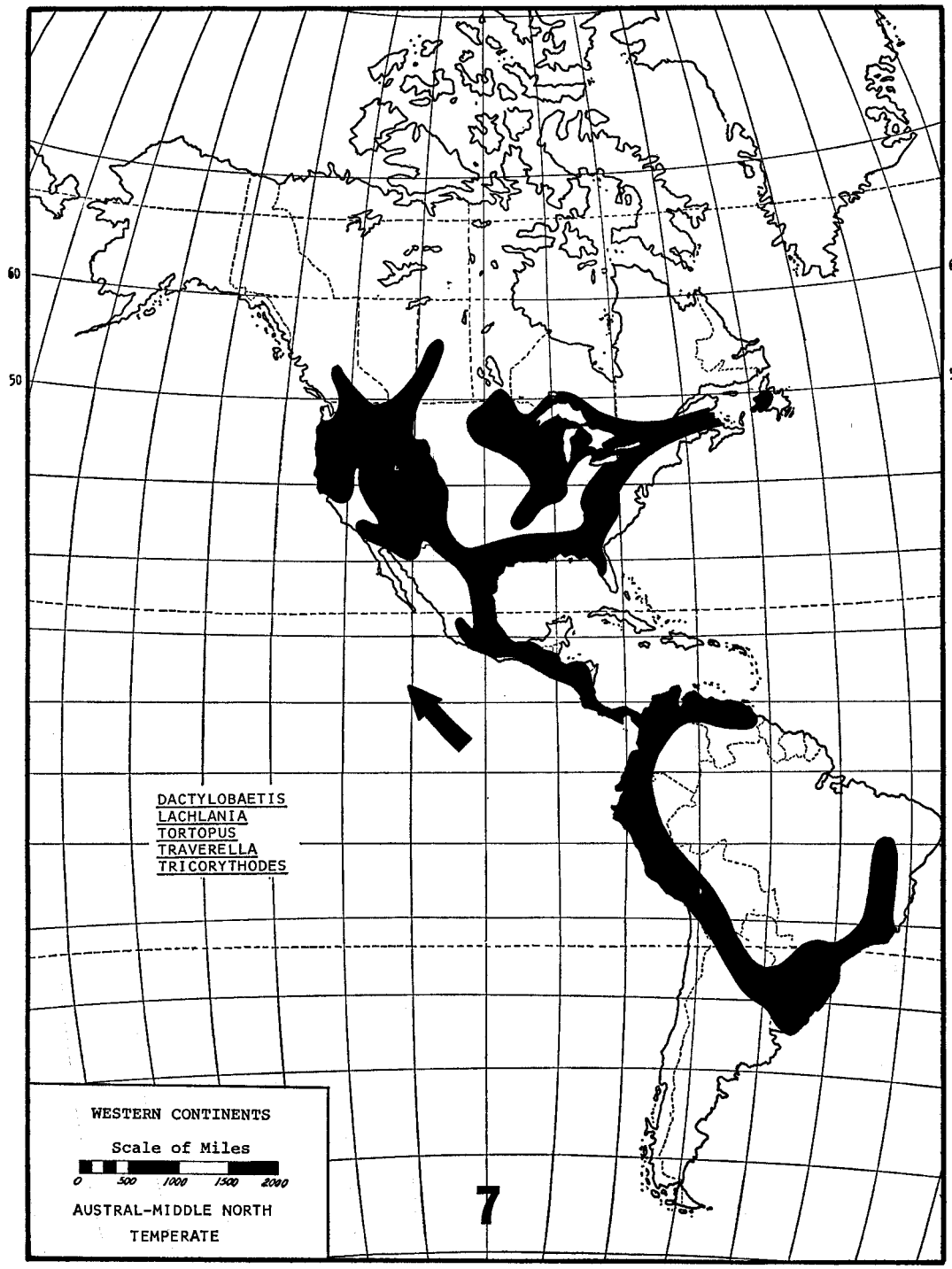
The genus *Callibaetis* includes 75 species of which 51 are Neotropical and only 24 are Nearctic. The distribution of the genus in the Nearctic Region also adds evidence to the suggested austral origin as 19 of the 24 species were described from the southern United States and Mexico and only one species is known to occur as far north as Alaska.

The genus *Hexagenia* reportedly occurs in the Old World as 2 species have been described from the Ethiopian Region, and 1 is known from the Oriental. The genus has not been reported from the Palaearctic and Australian Regions. In the New World, 4 species are known from the Neotropical, and 7 have been described from the Nearctic. In spite of the fact that the Nearctic species outnumber the Neotropical almost two to one, an austral origin is assumed for *Hexagenia* by the following evidence : (1) the Old World species are known from collections below the Tropic of Cancer; (2) present evidence suggests that the genus does not occur in the Palaearctic Region; (3) the genus is widely distributed in South America; and (4) the genus is not common and is represented by only a single species in the northern reaches of North America.

Genus of Unknown Origin

The genus *Choroterpes* includes 31 described species which are included in two subgenera, *Choroterpes* s. s., and *Euthraulus*. *Choroterpes* s. s. includes about 22 species of which 3 are Palaerctic, 2 are Ethiopian, 1 is Oriental, 10 are Nearctic, 6 are Neotropical, and the subgenus has not been reported from the Australian Region. The subgenus *Euthraulus* is presently known from only the Old World, and 4 species are Ethiopian and 5 are Oriental. The origin of the genus, based upon collection records is uncertain at this time. The distribution in the New World (Map 9) suggests a boreal origin while the distribution in the Old World suggests an austral origin. In the Old World 12 species are known from the Ethiopian and Oriental Regions compared to only 3 from the Palaearctic. In the New World the Nearctic species outnumber the Neotropical almost two to one.

The 10 species of *Choroterpes* in North America have scattered distributions and the Nearctic species are widely separated from the Neotropical as specimens of this taxon have never been



MAP 7. Austral-middle north temperate.

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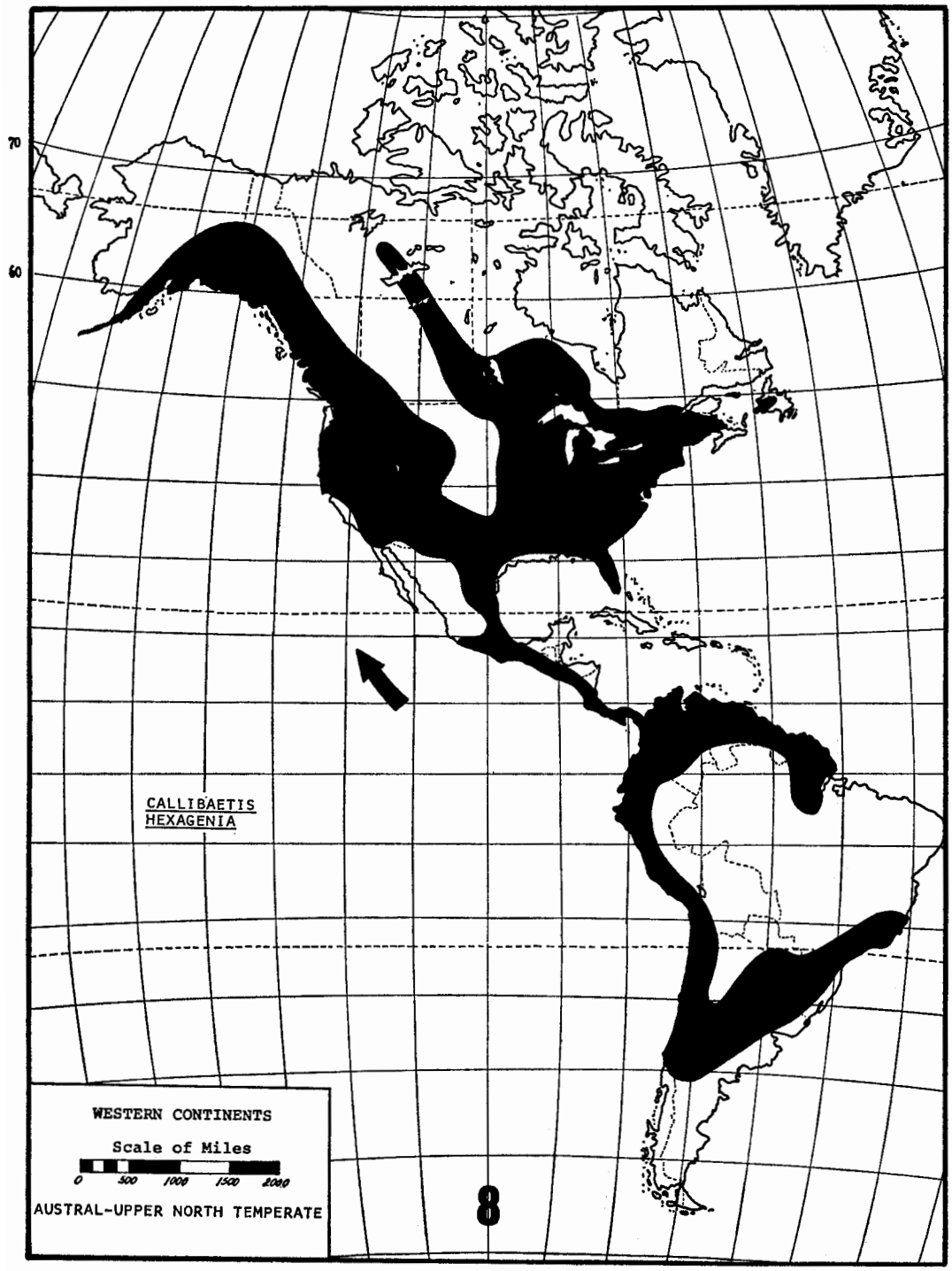

MAP 8. Austral-upper north temperate.

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collected between southern and northern Mexico. The most northern distributional limit of the Neotropical *Choroterpes* is in the Upper Tropical, and the most southern distributional limit of the Nearctic species is in the Lower North Temperate (Map. 9).

The New World genera *Caenis*, *Pseudocloeon*, and *Brachycercus* are known from North America, north of Mexico, and records of these genera also have been reported from South America. It is not certain that the identification of these genera in South America is correct, but records of these taxa from Mexico are unknown at this time.

Résumé

Ce que l'on sait de la distribution géographique en Amérique du Nord des genres d'Éphémères du Mexique (Insecta : Ephemeroptera)

Une revue des connaissances sur la distribution des genres mexicains a fourni des données supplémentaires sur l'origine et la distribution limite des espèces d'éphémères de l'Amérique du nord. Il y a 21 genres actuellement connus au Mexique, 8 sont considérés comme ayant une origine boréale, 12 australe et un genre *Choroterpes* a une origine discutable. Nous proposons une classification de leur distribution comprenant sept catégories et une nouvelle terminologie pour exprimer les limites de la distribution des genres mexicains. La nouvelle nomenclature est basée sur l'origine présumée du genre et la zone de température du globe dans laquelle est située la limite extrême sud de la distribution du groupe. Les genres et les latitudes extrêmes font l'objet d'une discussion pour chaque catégorie.

Zusammenfassung

Die bekannte Verteilung der mexikanischen Eintagsfliegengattung in Nord Amerika (Insecta : Ephemeroptera)

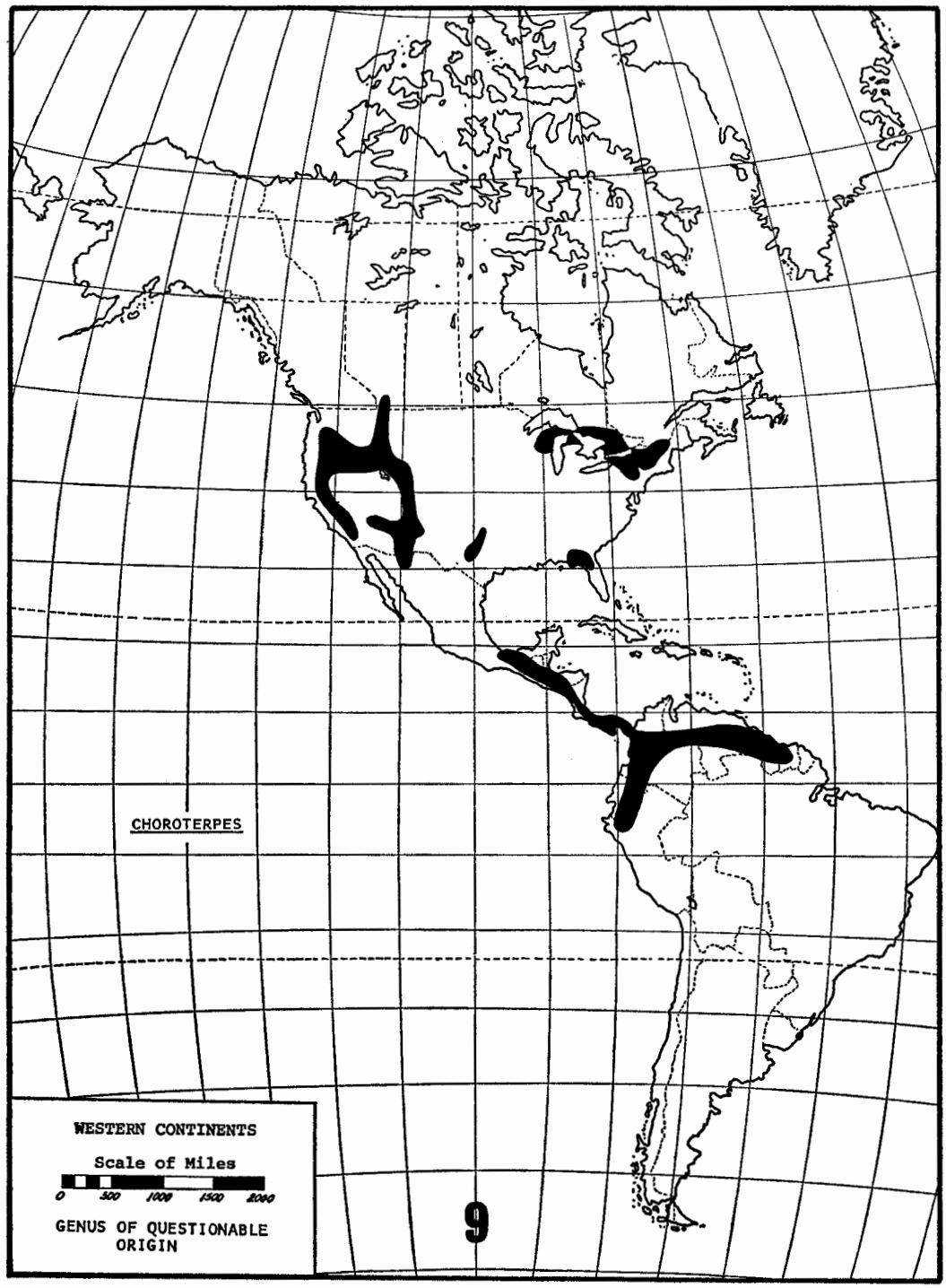
Eine Überprüfung der bekannten Verteilung der mexikanischen Gattungen brachte zusätzliche Informationen zu den ursprünglichen Verteilungsbeschränkungen der nordamerikanischen Ephemeroptera. Zur Zeit sind 21 in Mexiko vorkommende Gattungen bekannt. Der Norden wird als Ursprung von 8 gehalten, 12 werden vom Süden klassifiziert: der Ursprung der Gattung *Choroterpes* ist jedoch fraglich. Wir planen eine Verteilungsklassifizierung mit sieben Kategorien und neuer Terminologie, um die Verteilungsbeschränkung der mexikanischen Gattungen auszudrücken. Die neue Nomenklatur ist auf dem vermutlichen Ursprung der Gattungen, und auf die Temperaturzone der Erde wo die Gattung die nördlichste und südlichste Verteilung erreicht, aufgebaut. Die Gattungen und deren latidudinale Beschränkungen sind für jede Kategorie besprochen.

Discussion

L. Berner : I would like to point out that *Stenonema* does occur further south in Florida than you have shown us.

R. Allen : I extended the distribution of *Stenonema* in Texas also on my last trip.

L. Berner : *Stenonema* extends to the Tampa area in Central Florida.



MAP 9. Genus of questionable origin.

from A.J. Nijstrom & Co., Desk Map No. 8

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